

State of Tennessee



State of Tennessee
DRAFT Research
regarding
Multi-year Strategy for Improving Performance of
Projects and Project Teams

presented by

Bob Oglesby, AIA, LEED AP
State Architect
Office of the State Architect (OSA)

DRAFT

August 2012

Role of the State Architect

Provide operational and technical staff support to the State Building Commission (SBC) which approves funding for all projects associated with improvements to real property

SBC's chief staff officer responsible for implementing its by-laws, policies and procedures

Assist SBC in making informed and timely decisions

SBC's responsible party for recommending, then developing and implementing SBC approved initiatives, programs and policies

- facilitated through the three **State Procurement Agencies (SPAs)** – DGS's STREAM, TBR and UT
- assisting SPAs so their projects are expeditiously approved and delivered efficiently and responsibly

One of OSA's goals is to be strategic and develop a long term vision to be implemented in phases over a multi-year time frame for SPAs to roll out

SBC continues to be interested in considering any items which may achieve a higher and better use of taxpayer dollars spent on improvements to real property

Reasons I was selected State Architect include my previous private sector professional experience and ability to bring about meaningful process changes

I research and recommend for SBC's consideration items I believe may:

- create greater owner value and
- will lower the State's total cost of ownership through
 - more efficient and effective design, construction and operational processes
 - the realization of higher performing buildings throughout their entire life cycle

Examples of the types of items my office has either already brought forward and gained acceptance of or is currently researching which may be brought to the SBC for their consideration in the future include:

Owner items:

More efficient and effective approval and decision making processes at SBC, SPA and / or the design, construction, operations level.

Examples include:

More delegation of duties from SBC to the OSA, F&A and SPAs to expedite small cost and low risk projects / transactions

- One recent delegation is:
 - Maintenance projects <\$500,000 funded by certain sources can now be approved by my office and the budget office with only reporting after the fact back to the SBC

More consistency in SPA processes and reporting

- Example:
 - Change order approvals and reporting

Increased emphasis on SBC / OSA oversight and SPA leadership and management of project scopes, budgets and use contingency funds to reduce the number of Owner requested scope and budget revisions and related change orders

The State needs to be able to

- more accurately develop project scopes and budgets before budget requests are submitted and project funding is authorized, and
- better manage those projects to their approved targeted budgets and schedules

Examples:

- General government's / STREAM's **operational pre-planning** of projects
 - making a business case for each request prior to bringing it forward, as well as
 - to better define project scopes, expectations, and budgets before starting the design and construction process
 - to expedite project approvals, minimize future SBC revision requests, and have tighter project controls
- Furthering the Statewide use of **design and construction pre-planning** of projects to assist in scope definition and budgeting
 - development of a project's design, budget and schedule to the extent necessary for each project's specific needs
 - overlapping this pre-planning work with the budget request cycle thus shortening the time it takes from budget request to occupancy

Recent study conducted internally and confirmed by consultants identified the normal State processes to

- identify and plan a project,
- request funding and get funding approved, then get project approved,
- select a designer, design the project,
- procure a contractor and construct a 9 month construction duration project
- took at least 39 months

Proposals have been made as to how we can reduce this down to 21 months

- Starting the budget process with an Operational business case for each project in hand
- Overlapping budget process with Project Design and Construction Pre-Planning
- Using a CM at Risk delivery method with early design phase involvement

Currently researching ways to reduce the time frame while improving quality control of process even more

Owner items:

More efficient and effective approval and decision making processes at SBC, SPA and / or the design, construction, operations level.

Examples include:

Results from an upcoming LEAN event

- I am participating in this event at the request of TN Department of Environment and Conservation (TDEC) working with STREAM
- Focus is on how the Owner, and designer team all work together during the Schematic Design through Bidding/Negotiation phase
- Goal is to determine how STREAM and other SPAs can better structure and implement its project processes to be more efficient and effective to
 - Better define / redefine roles, responsibilities, and accountabilities
 - Reduce waste – the amount of rework, handoffs, redundancies and delays
 - Develop standard operating procedures for other agencies use as well

The following information is highlights of content found on the LEANConstruction.org website

The LEAN Construction Institute (LCI) operates as a catalyst to transform the industry to deliver projects using a lean operating system centered around a common language, fundamental principles and basic practices.

Research projects, studies, white papers etc. include:

- One of the challenges of the industry is how to manage work flow, especially in the design phases of capital projects

- LCI extensively studied a full service design and construction project (5 months to design) specifically to track when and why tasks were not-completed on time
- Those reasons include:
 - Lack of decision
 - Lack of prerequisite work
 - Lack of resources
 - Priority change
 - Insufficient time
 - Late start
 - Conflicting demands
 - Acts of God or the Devil
 - Project changes
 - Other
- Three categories dominated the most frequent reasons
 - Lack of prerequisite work 31%
 - Insufficient time 28%
 - Conflicting demands 19%
 - Totaling 78%

Positive vs. Negative Iteration in Design

- Iteration is essential for generating value in design processes
- However, not all iteration generates positive value
- Iteration that can be eliminated without value loss is waste
- How to reduce waste through elimination of negative iteration
- Informal surveys of design teams reveal estimates as high as 50% of design time is spend on needless (negative) iteration
- Other types of waste in design include design errors and design failures due to lack of knowledge not previously possessed

Reduction Strategies

Reorganize the design process

- Eliminate or reduce sequential processing in favor of genuine team problem solving by cross-functional teams
- Define / share the range of acceptable solutions (values) amongst all decision makers in lieu of individuals competing for maximum priority of their criteria over others
 - Willingness to share incomplete information is necessary for concurrence in design

Restructure the design process

- Use a Design Structure Matrix (DSM) – a device for reducing or eliminating iterative loops by re-sequencing design tasks
 - Make every effort to maximize customer value as a result of trade-offs between needs and objectives
- Produce a work sequence by having the team responsible for the work being planned to work backwards from a desired goal – by creating a “pull” schedule
 - Reducing batch sizes to eliminate only completed design work can be advanced to others

Reduction Strategies

Change how the design process is managed

- Deferred commitment is a strategy for avoiding premature decisions and for generating greater value in design
 - Doing so avoids incorporation of customary but unnecessary work, and yields the identification of tasks defined in terms of what releases work and thus contributes to project completion
 - So doing also results in reducing the waste of overproduction

Another critical LEAN approach which leverages integrated project delivery method's value is:
Target Value Design

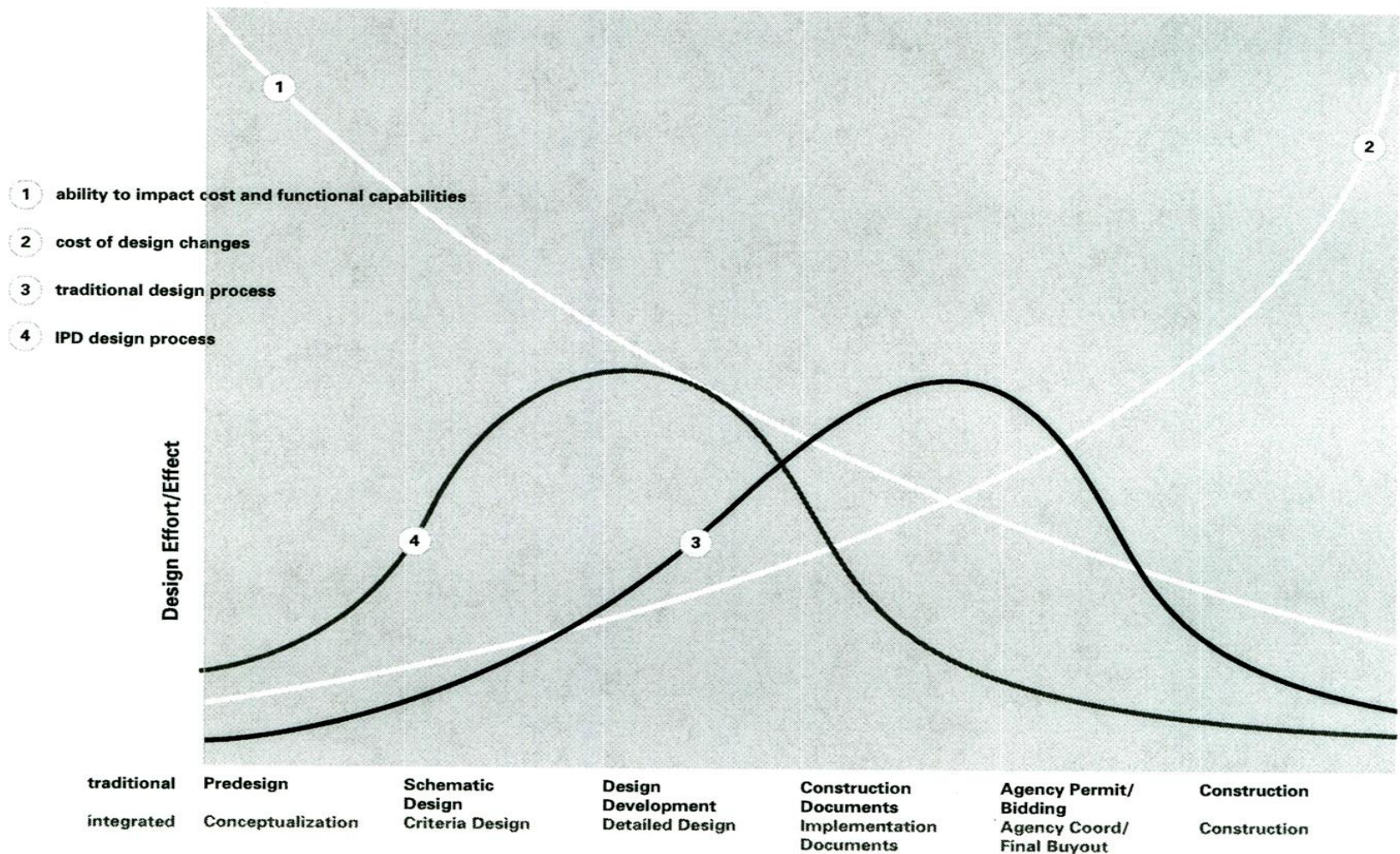
- Discourage / avoid design that is performed by team members in silos. This leads to projects that are often over budget, delayed, ineffective.
- Rework, re-pricing, change orders, and de-value engineering are all symptoms of a process which ignores the nature of design and the value added to an integrated systems solution.
- Rather than estimate based on a detailed design, design based on a detailed estimate.
- Rather than evaluate the construct ability of a design, design for what is constructible.
- Rather than design alone and then come together for group reviews and decisions, work together to define the issues and produce decisions then design to those decisions.
- Rather than narrow options to proceed with design, carry solution sets far into the design process.
- Rather than work alone in separate rooms, work in pairs or larger groups face-to-face.

Summary Focus:

- Pursuing Transformation Goals re: High Performance Projects and High Performance Project Teams
 - Owner performing Operational Pre-Planning to make a business case for projects before starting the design and construction process
 - Leveraging the use of integrated project delivery methods and re-defining roles, expectations and design process involving Owner representatives and consulting designer, consultants, and contractor for more collaborative, timely, efficient and effective decision making
 - Utilizing design and/or construction consultants to provide Design and Construction Pre-Planning when needed to finalize Owner expectations on project quantity, quality, cost, schedule, performance
 - Collectively establishing scope, schedule, budget, energy consumption, building performance in pursuit of developing and operating High Performing Projects

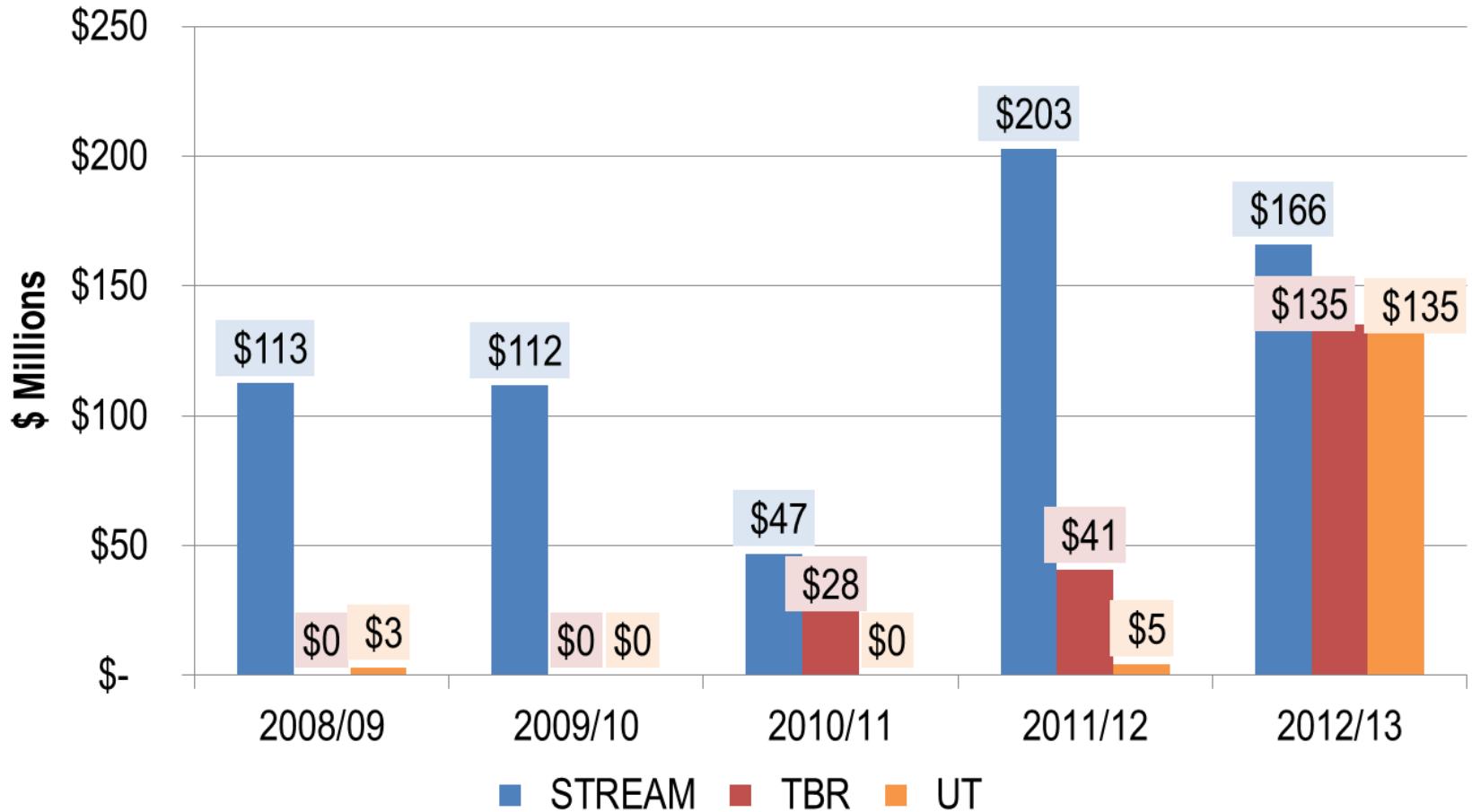
- Reorganizing the design process utilizing cross functional team problem solving vs sequential silo decision making
- Restructuring the design process to re-sequence design tasks, and reduce or eliminate reiterative loops, negative iterations and waste
- Generate greater value in design by deferring decision making until the last possible moment to avoid premature decisions and additional loops
- Utilizing a Target Value Design process – through early involvement of contractor to design to budgets and reduce/eliminate negative iterations such as re-design and value engineering
- Using technology including BIM to improve visualization and communication, to share information during design, construction and operations, and support our high performance building goals
 - Recognizing BIM encourages / supports positive cultural and process changes
 - BIM makes energy modeling easier
 - Adjustments in consultant fee schedules would need to be addressed.

Macleamy Curve

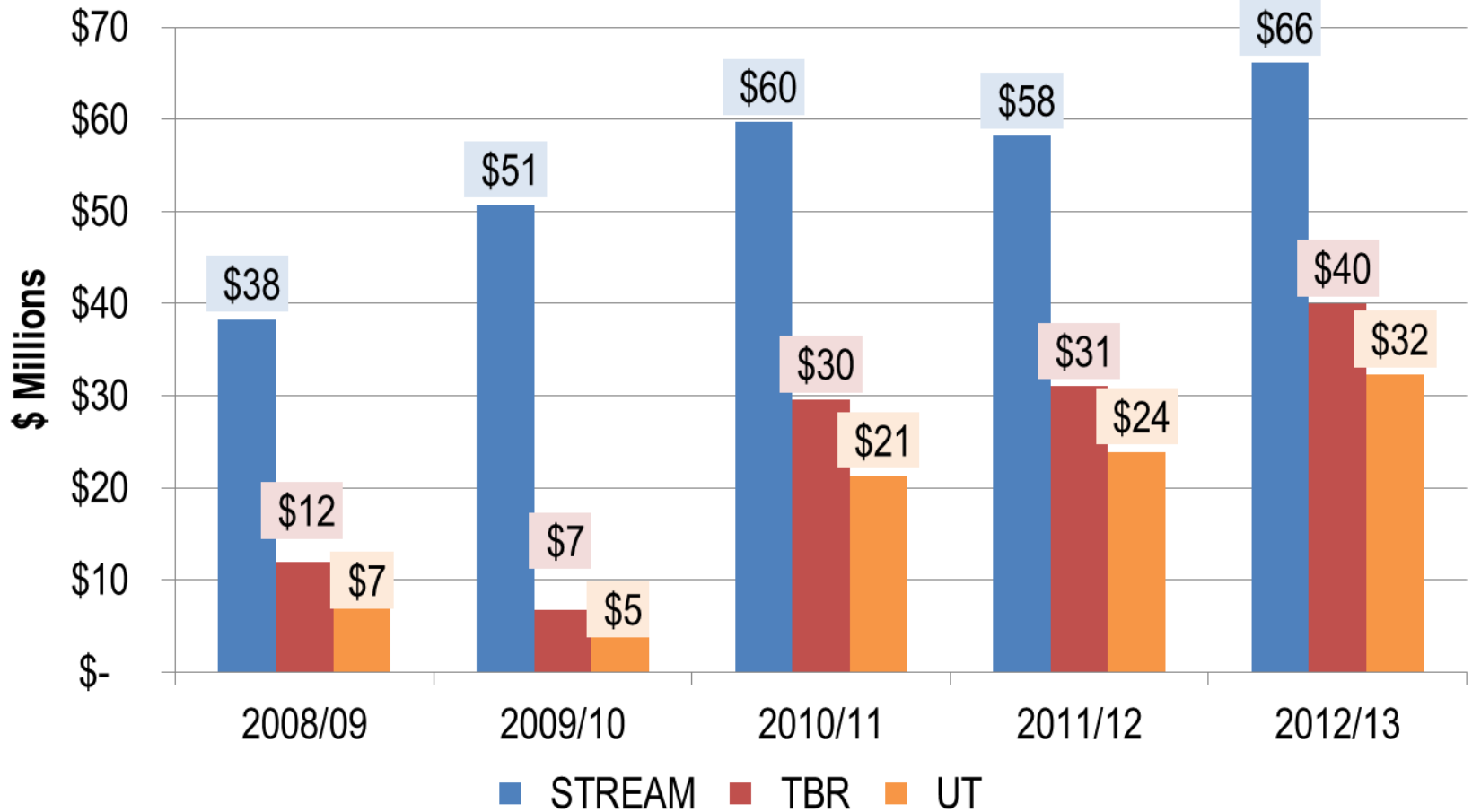


State of Tennessee
Historic Review of Capital Budgets
2008/9 – 2012/13

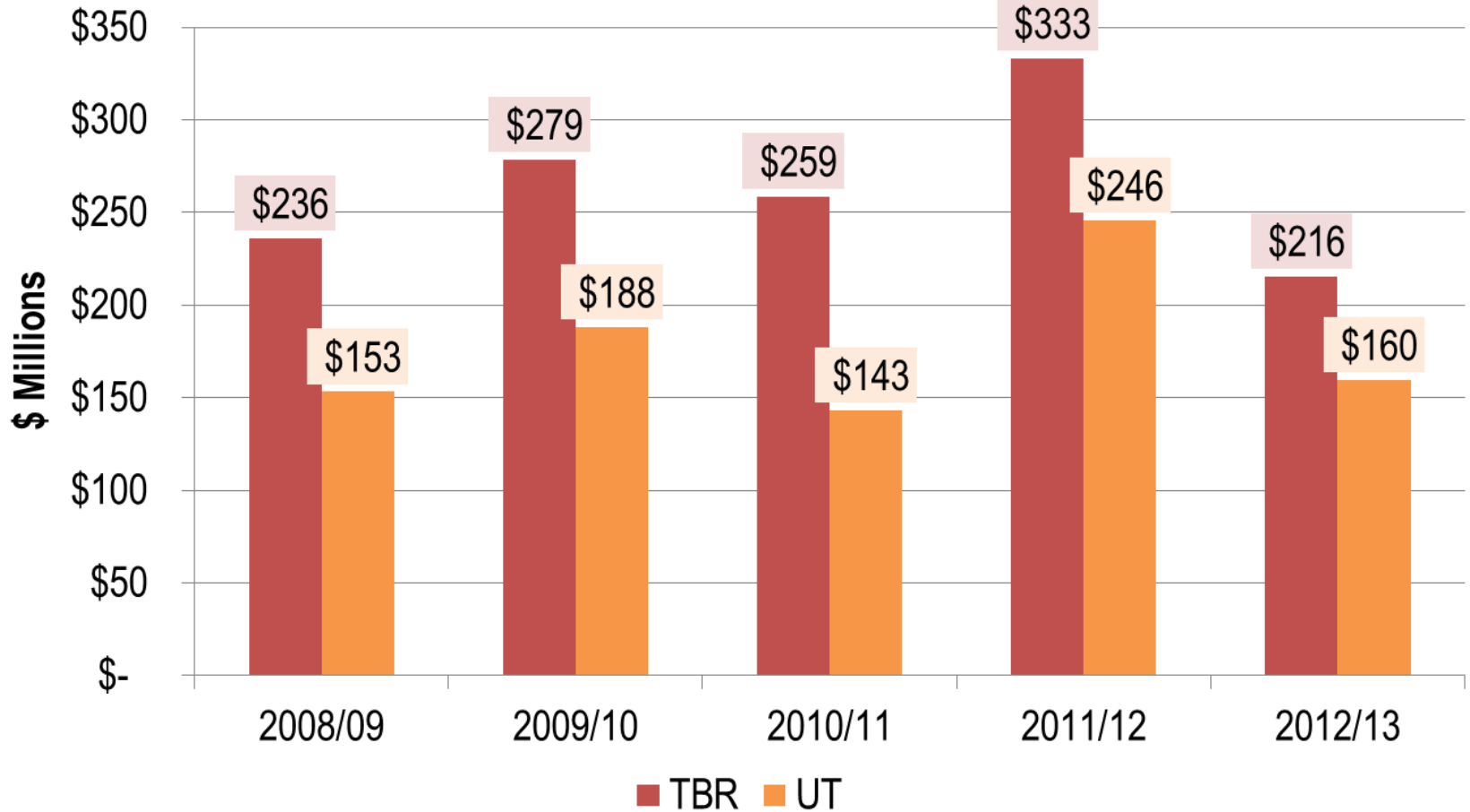
Capital Improvements



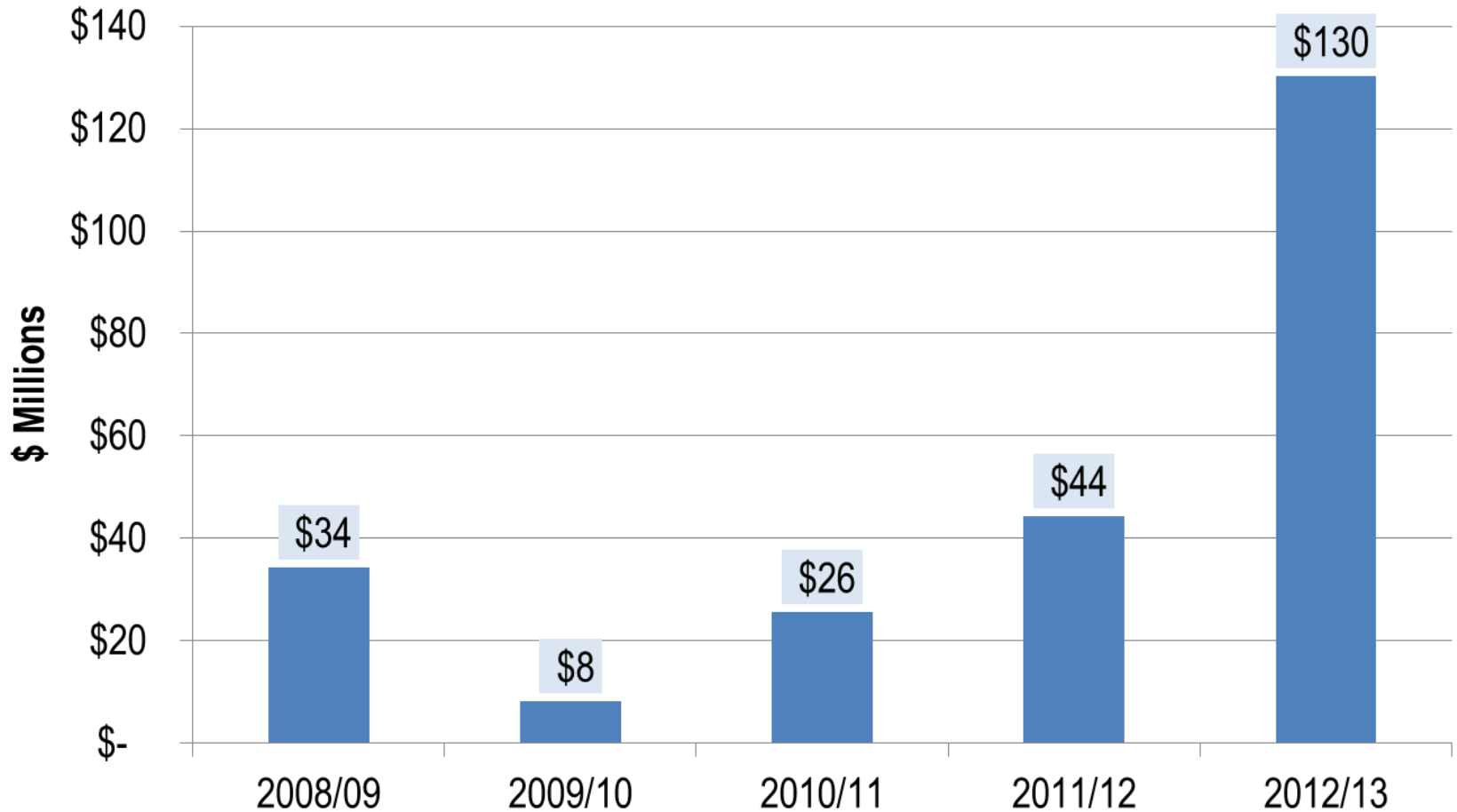
Capital Maintenance



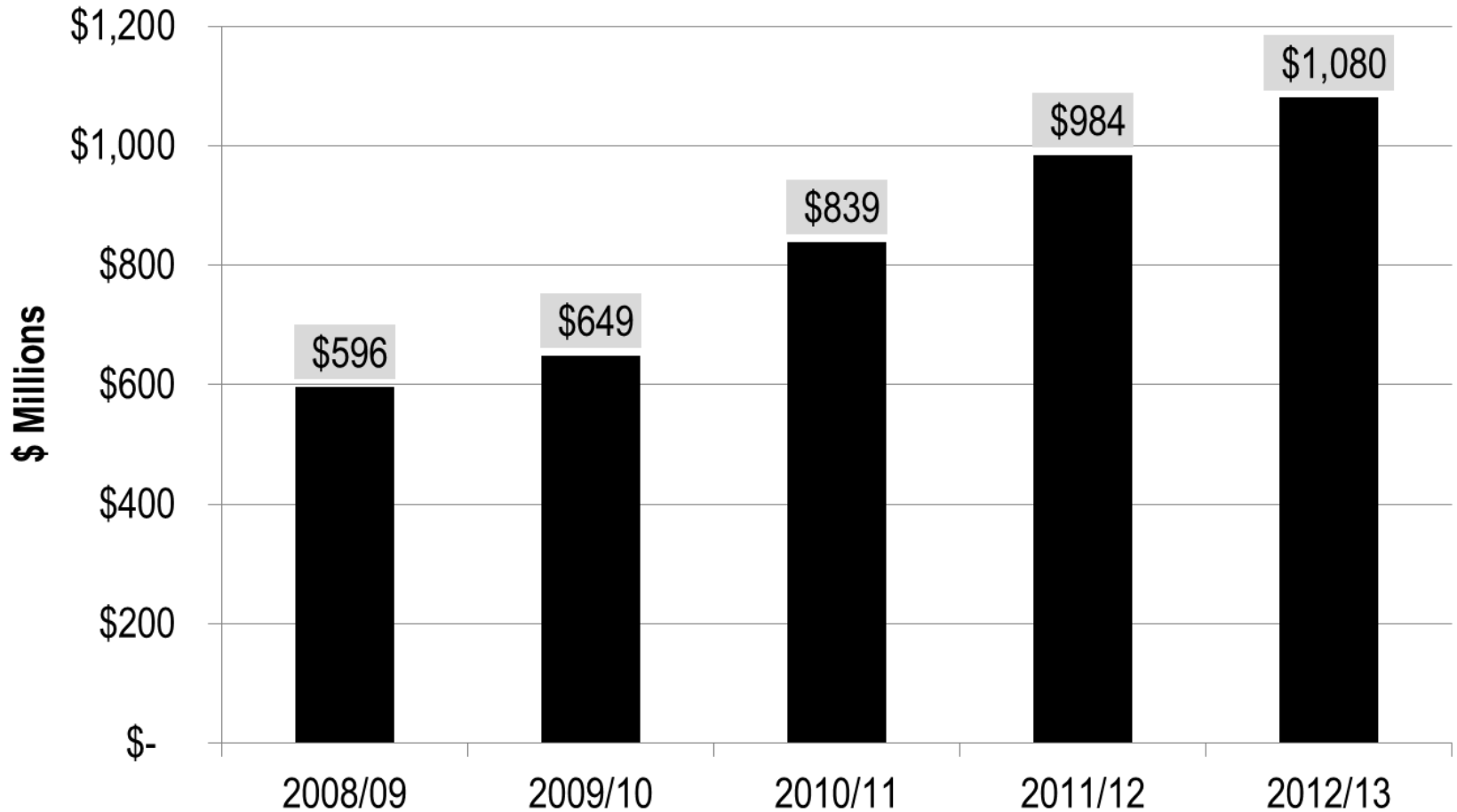
Capital School Bonds and Other Sources



Facilities Revolving Fund - STREAM

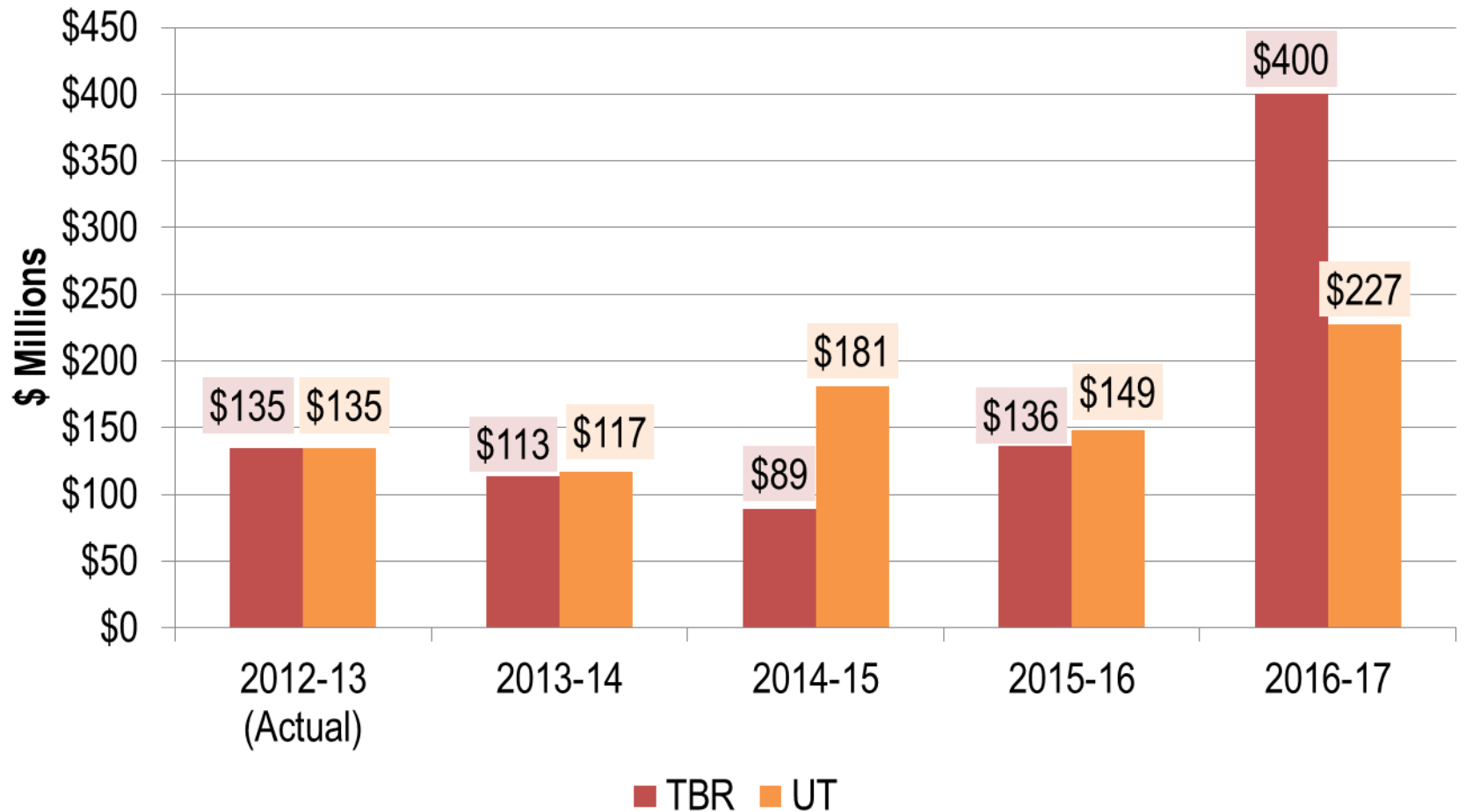


Capital Budget Grand Total

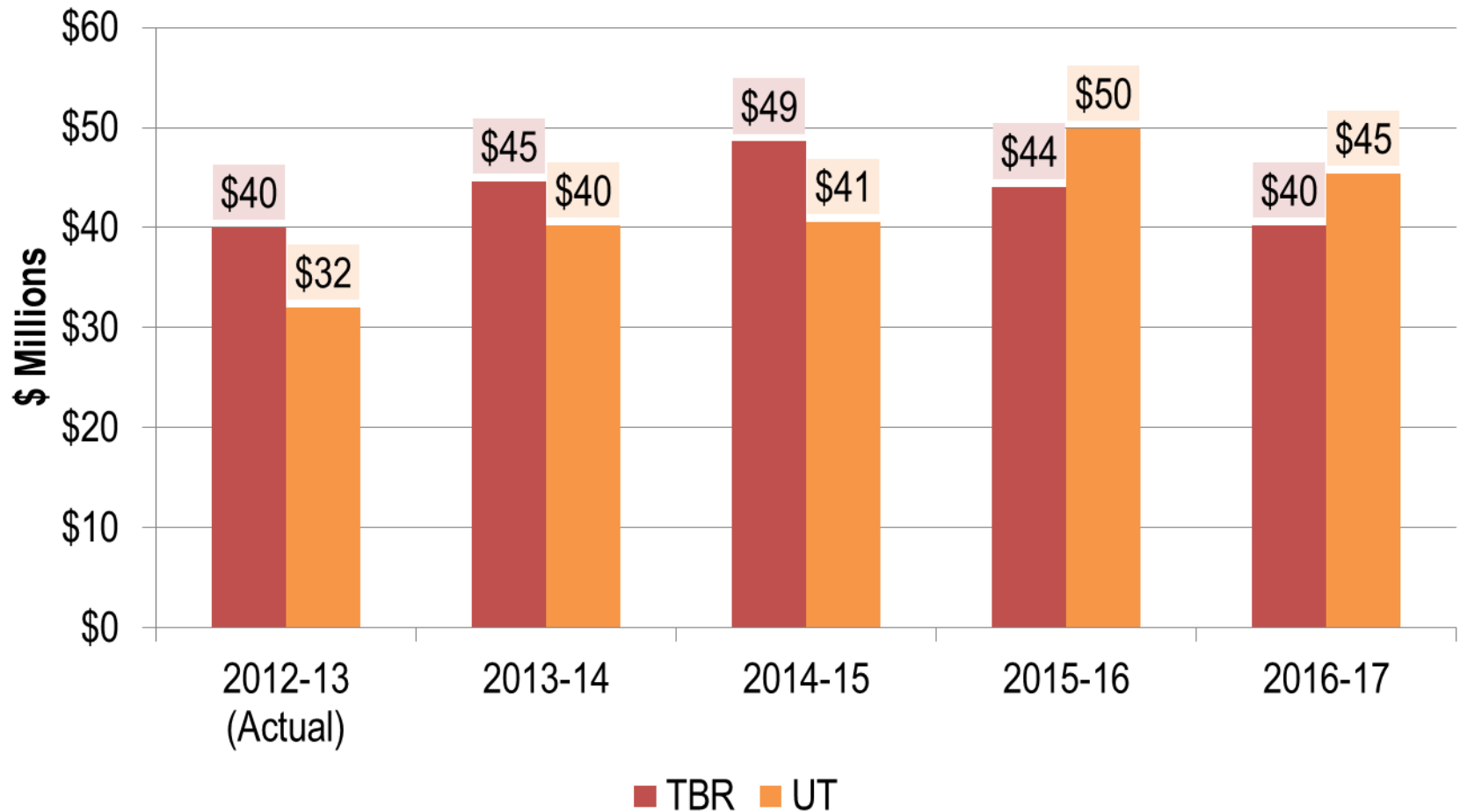


State of Tennessee
Proposed Higher Education Capital Budgets
2012/13 – 2016/17

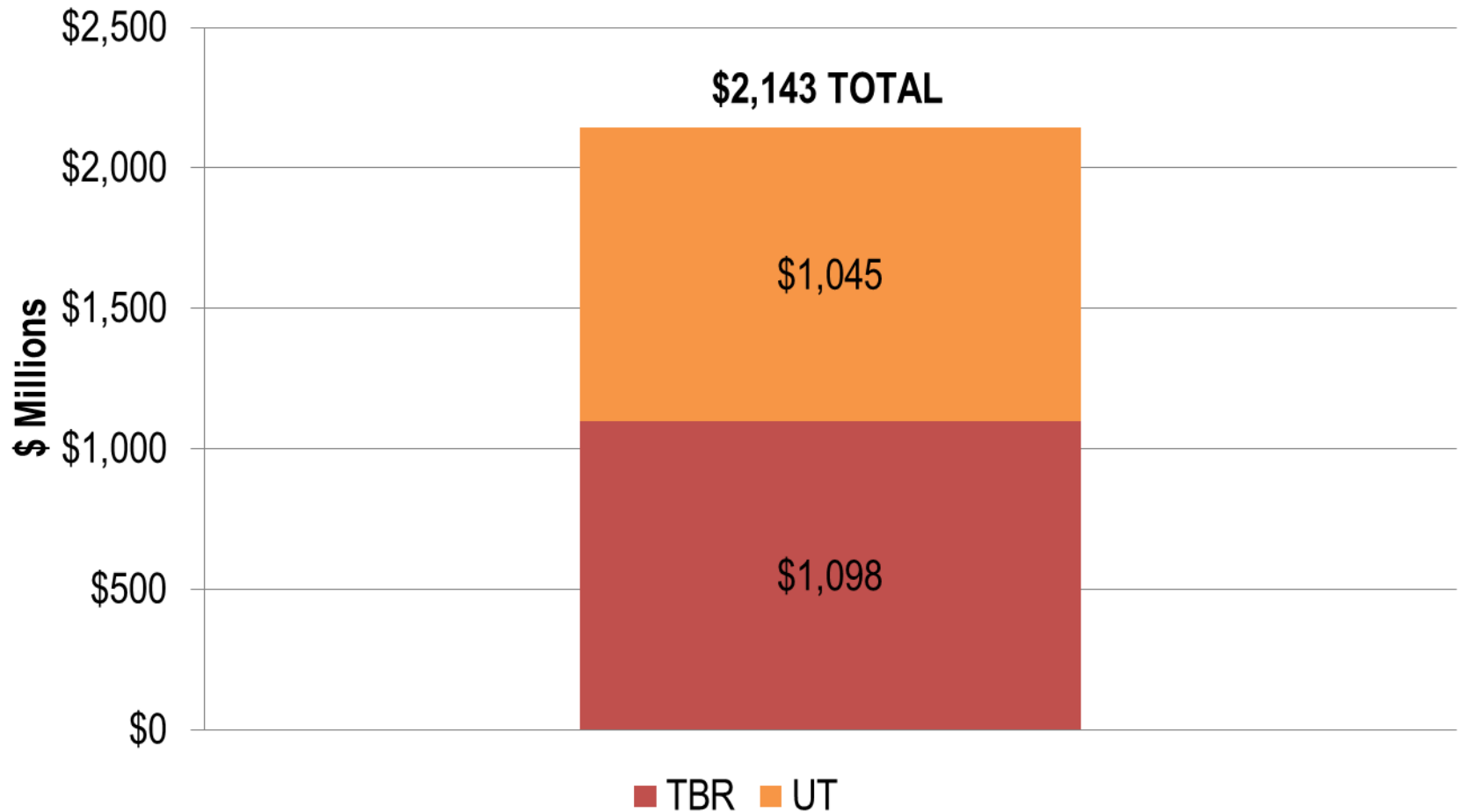
Proposed Capital Outlay



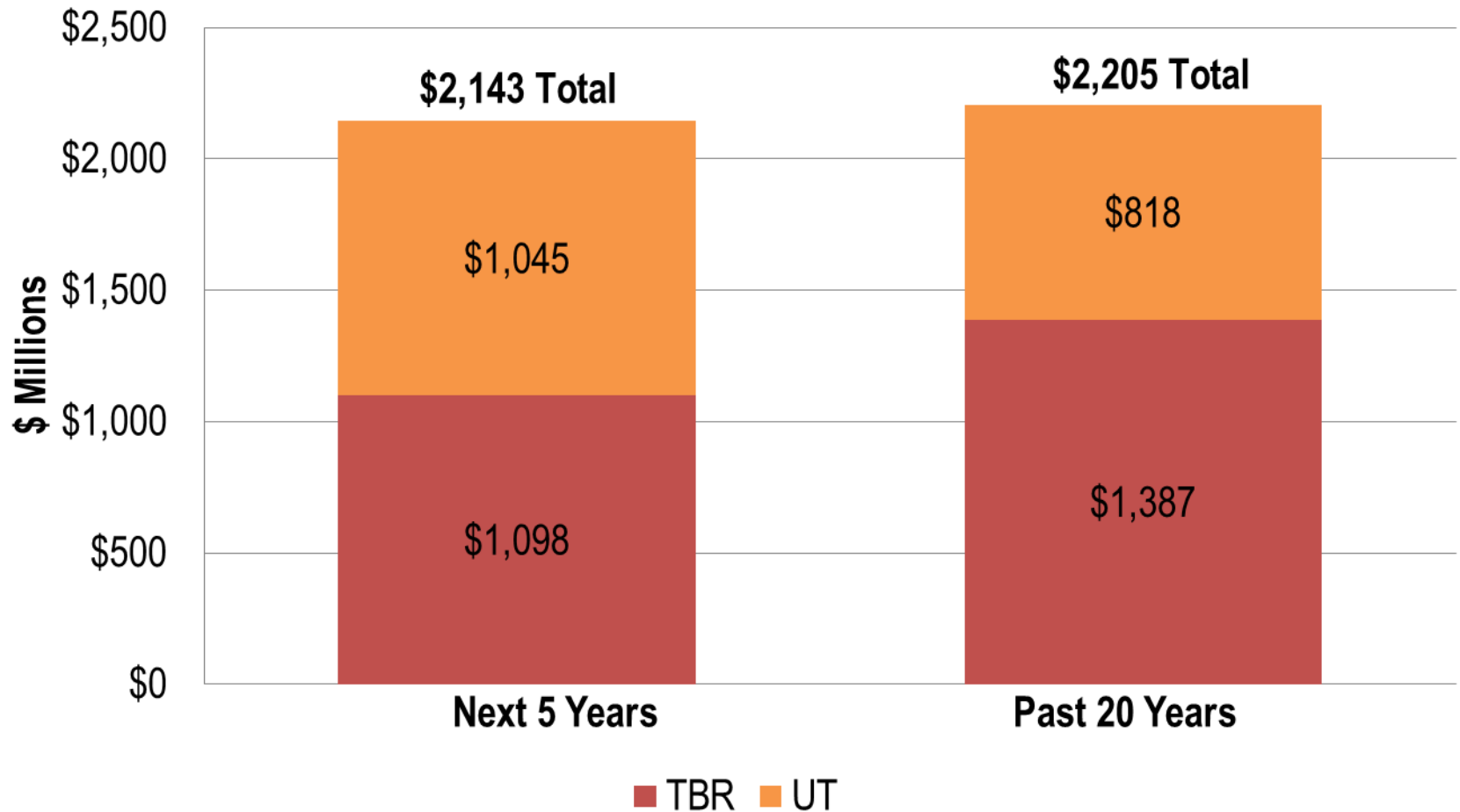
Proposed Capital Maintenance



Five-Year Total Capital Investment



Total Capital Investment



These next items are only in the research and development phase prior to any SBC consideration. Before bringing these forward as part of any Owner initiative requires great efforts and thought especially when it requires industry involvement.

Part of my interest in talking about these items today is to further my research by getting your feedback and perspective on these items before actually bringing forward any of these items to the SBC for their consideration.

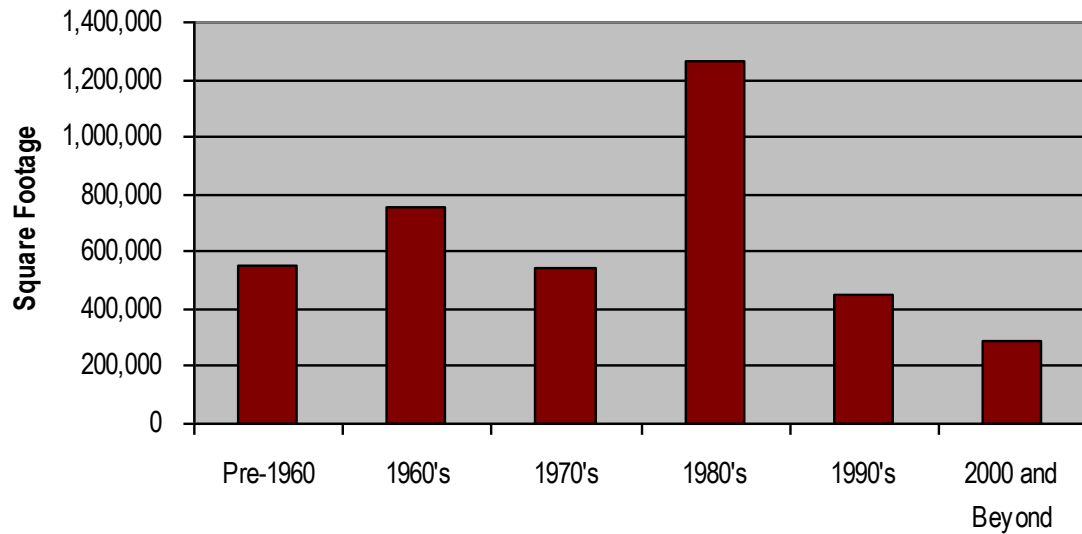
Envision a New World of
Design & Construction Excellence –
Developing and Operating High Performance Buildings
and Project Teams

Envision the State's portfolio if one day:

- The majority of projects were designed, built or renovated with the intention of actually lasting 100 years
- When compared to similar projects ten years earlier
 - Cost very little or no more initially to construct or renovate
 - Were highly energy efficient to operate - utilizing 30-50+% less energy on average
 - Were able to be well maintained at significantly lower maintenance costs at rates equal to current industry standards
- The buildings were aesthetically pleasing and functionally designed to
 - add long-lasting cultural value to the area in which they exist and
 - help their inhabitants to be more healthy and productive
 - utilizing current technology, engineering systems, and the best work practices of the day
 - resulting in the occupants being more productive and taking fewer sick days

Current FRF Buildings

- Average Age of Owned Portfolio is 35 years
- However, the oldest 43% of the portfolio has an average age of 50 years
- Architecture and technology have surpassed current portfolio



Chattanooga State Office Building
Built 1955



Donnelley J. Hill
Built 1968



Lowell Thomas State Office Building
Built 1977



Citizen's Plaza
Built 1986



Davy Crockett
Built 1989

FY 11/12 FRF (General Government General Office Buildings) Spend Analysis

Above Industry Standards

Utilities costs	30+%
Repairs and Maintenance costs	63+%

To get to this new future destination, we need to first envision a new design, construction, and operations world where:

- facilities managers, end users, designers, contractors and suppliers are all involved at the start of the design process
- processes are outcome-driven and decisions are not made solely on a first cost basis
- all communications throughout the process are clear, concise, open, and transparent
- designers fully understand the ramifications of their decisions (time, budget, quality, etc.) at the time the decisions are made
- risk and reward are value-based and appropriately balanced among all team members over the life of a project
- the industry delivers a higher quality and higher performing project

The Integrated Project Delivery Guide was jointly developed
by AIA's Contract Documents Committee and the AIA
California Council.

Integrated Project Delivery is a project delivery process that:

- Collaboratively harnesses the talents and insights of all participants
- Optimizes project results:
 - Increases value to the owner
 - Reduces waste
 - Maximizes efficiency through all phases of design, fabrication and construction

The process is distinguished by:

- Highly effective collaboration among Owner, designers and contractors at a minimum
- Commences at early design
- Continues through to project handover or later

To do so requires the Owner's decision to use an Integrated (Design and Construction) Project Delivery Method

- Leverages early contributions of knowledge and expertise
- Through utilization of new technologies like BIM, the values such highly collaborative delivery methods offer can be further expanded

IPD provides positive value propositions for the three major stakeholder groups:

- ***for Owners***

- the integrated delivery strengthens the project team's understanding of the owner's desired outcomes
- improves the team's ability to control costs and manage the budget, which
- increases the likelihood that project goals –
 - schedule
 - life cycle costs
 - quality

will be achieved

IPD provides positive value propositions for the three major stakeholder groups:

- ***for Contractors***
 - allows them to contribute expertise in construction techniques early in the design process
 - results in improved project quality and financial performance during the construction phase

IPD provides positive value propositions for the three major stakeholder groups:

- ***for Contractors***
 - the contractor's participation during the design phase provides –
 - strong pre-construction planning
 - more timely and informed understanding of the design
 - anticipating and resolving design-related issues
 - visualizing construction sequencing prior to construction start
 - improved cost control and budget management

IPD provides positive value propositions for the three major stakeholder groups:

- ***for Designers***

- allows the designer to benefit from the early contribution of contractor's expertise during the design phase –
 - accurate budget estimates to inform design decisions
 - pre-construction resolution of design-related issues
 - improved project quality and financial performance

Integrated Project Delivery is built on collaboration which, in turn, is built on trust

- Effectively structured, trust-based collaboration encourages parties to focus on project outcomes rather than their individual goals
- Without trust-based collaboration –
 - IPD too will also falter and participants will remain in the adverse and antagonistic relationships that plague the construction industry today

Design / Construction Team Items:

Three items focus on improving value of project teams and building projects:

The first Design / Construction Team Item:

Utilization of more collaborative integrated (design and construction) delivery methods

- Better utilization of available project delivery methods based on individual project needs, and owner expectations regarding project and project team performance
- Increasing collaboration between designers and contractors during the design process and the early involvement of contractors

“Traditional” Design-Bid-Build (D-B-B) delivery method continues to be most widely used delivery method, especially by the public sector

- Provides competitive bidding environment
- Provides clear separation of designer and contractor responsibilities and liabilities
- Requires the least effort by Owners on the front-end

However, D-B-B can sometimes

- Create adversarial relationships between the designers and contractors
- Award contracts to low bidders that aren't the most qualified
- Result in numerous Change Orders and RFIs
- Not always be the lowest cost method in the end

While D-B-B will remain the best choice on certain projects, many industry experts now realize other methods may be better suited for certain project types and situations

For instance, when a project is such that some or all of the following conditions exist:

- Scope is not well defined,
- Budget is not well defined,
- Schedule needs to be expedited,
- Complexity level is above average,
- Would benefit from early contractor involvement, and high levels of collaboration between the design and construction team members

OSA's current policy on Alternative Delivery Methods is based on the State's Quality in Construction (QIC) Task Force's work product.

- QIC was comprised of members from the design and construction industry and various state agencies which engage in building projects and met in 2004/5 and 2009/10

QIC identified various "alternative" delivery methods beyond D-B-B

- Best Value 1, 2, and 3 (BV1, BV2, BV3) - requires two part contractor submittal, first creating a short list of qualified bidders whose lowest bid will determine who is awarded the contract
- Construction Manager/General Contractor (CM/GC) - brings a contractor in early in the design process, providing pre-construction services, to work with the designer and owner to contribute to cost estimating, scheduling, and constructability reviews
- Design-Build (D-B) – provides a single point for responsibility by bringing the designer and contractor in at the same time under one contract

It is important to have options as each project has unique characteristics and requirements, so each project team should assess and determine the most appropriate Project Delivery method.

SBC Policy approved the use of these new Alternative Delivery Methods occurred in Dec. 2005

Summary of report - “Influence of Project Delivery on Sustainable, High Performance Buildings”

- November 2010
- University of Colorado research project funded by a grant through the Charles Pankow Foundation

To achieve HPB Goals, project complexity increases as does the demand for increased interdisciplinary collaboration including early involvement of participants, higher levels of communication, and compatibility (trust) between project team members

- Project delivery methods often impact the Owner’s ability to achieve higher levels of building performance
- Studies show Design-Bid-Build (D-B-B) strategies may not address the complex demands found in high performance building projects and actually may actually constrain the contractor’s ability to assist in achieving certain high performance building objectives

- Design team separation from the contractor reduces the opportunity for innovative solutions by the contractor and sub-contractors
- Additionally, the (early or late) timing of contractor involvement also is a key factor affecting a building's performance

In other words, it is very difficult to achieve high performance building outcomes without some form of integrated design process where the contractor is involved during the design process

An analysis of Construction Delivery Methods for U.S. Non-residential Vertical Construction

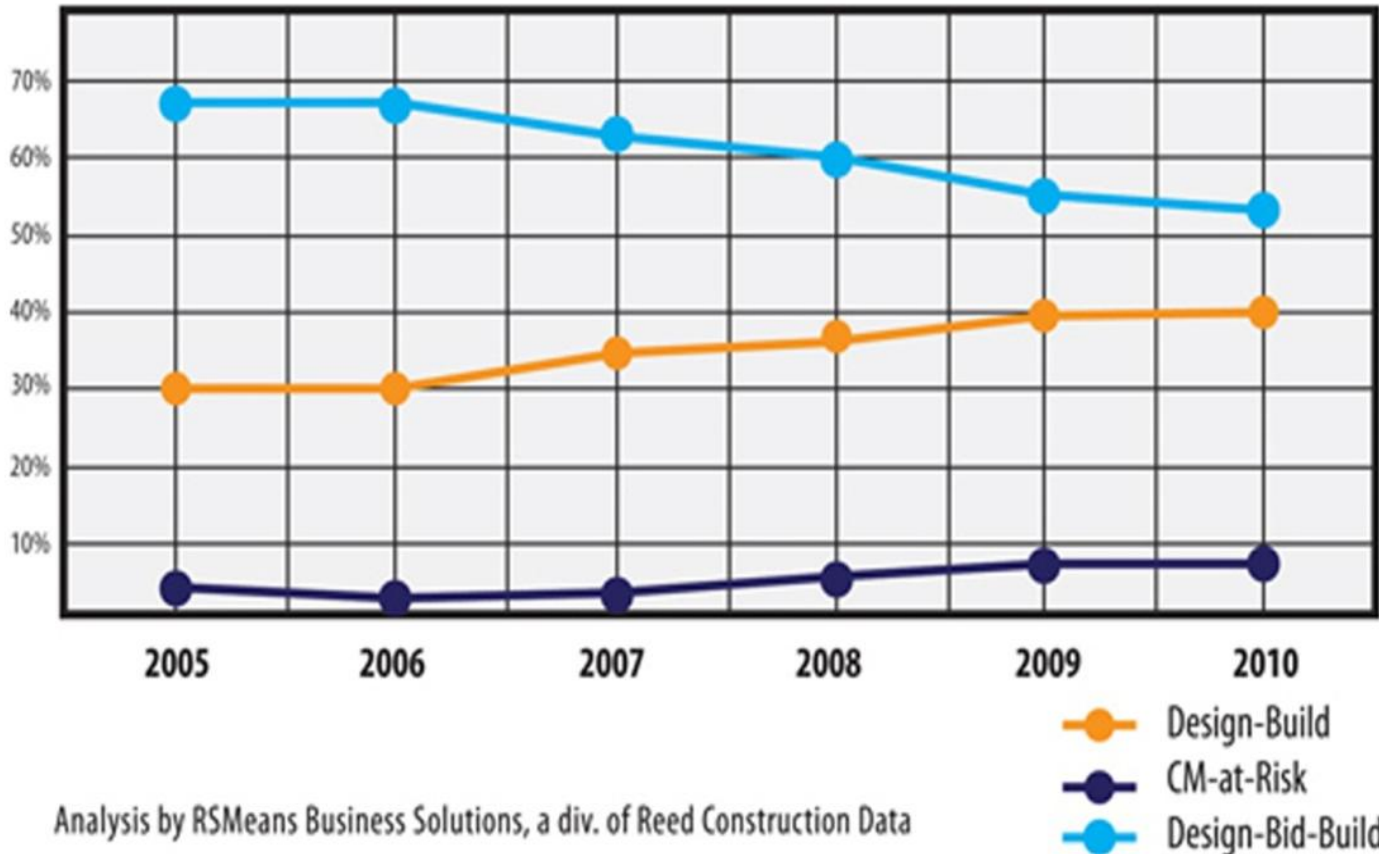
2005

67%
D-B-B

30%
D-B

3%
CM/GC

Project Delivery Method Market Share for Non-Residential Construction



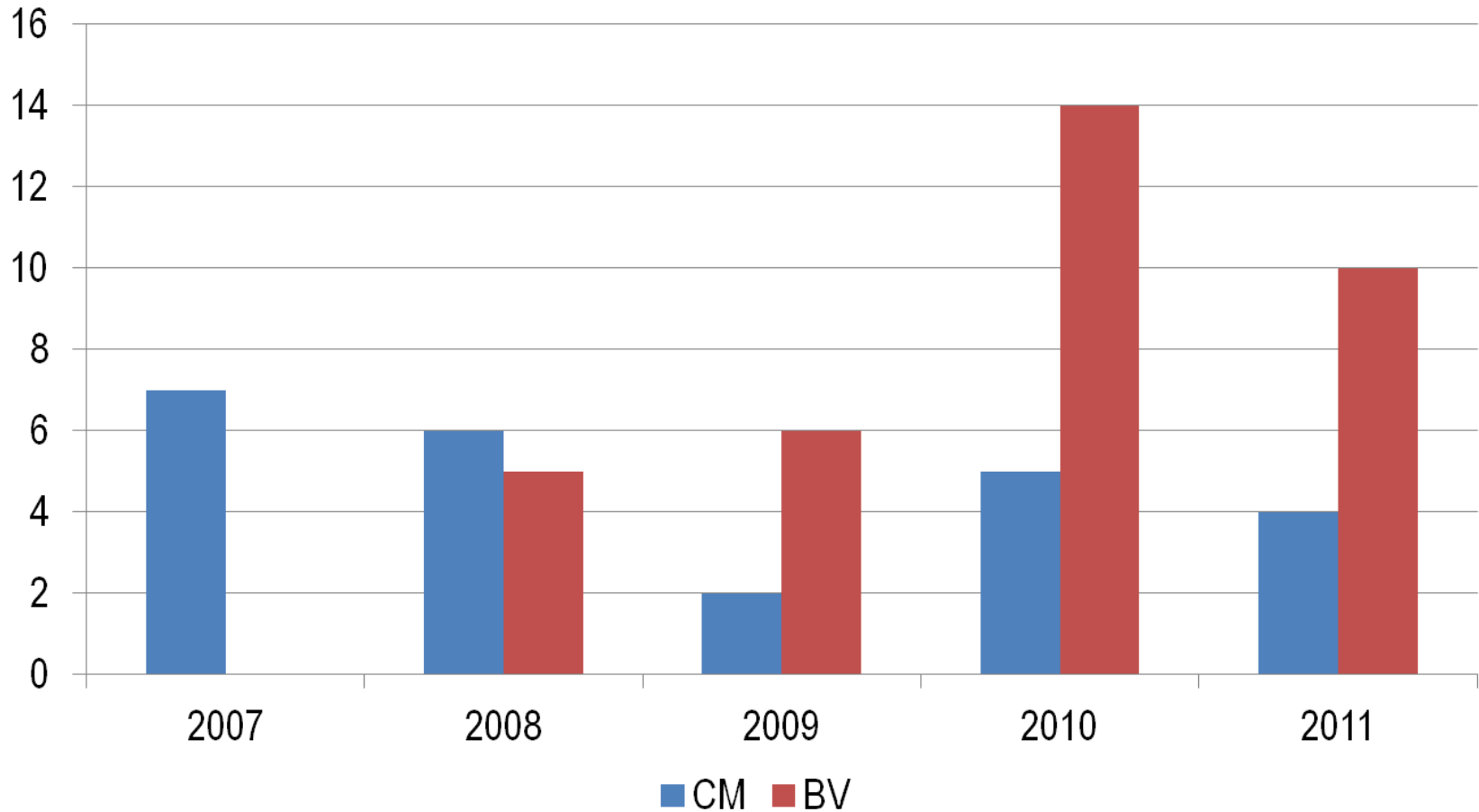
2010

52%
D-B-B

40%
D-B

8%
CM/GC

Alternative Delivery Method Totals Statewide



Considering Best Value (BV) as a Good Alternative Delivery Method Option over Design-Bid-Build (D-B-B)

In general, by utilizing Best Value on projects where Design-Bid-Build may traditionally have been used, the State should benefit from more qualified bidders, and thus reduce its risk via reduced construction rework and associated increases in costs, reduced delays in construction, reduced litigation, reduced number of Requests for Information (RFIs) and associated Change Orders (COs).

Best Value may be the preferred Alternative Delivery Method to D-B-B when the lowest bid is the only criteria for selection, but the Owner wants to be certain the contract is awarded to a qualified bidder, with expertise related to the project's scope of work.

The second Design / Construction / Operations Team Item:

Developing more High Performing Buildings (HPB)

- Higher Performing Buildings (HPB) are buildings with lower total costs of ownership and longer useful lives
- Now there is an increased appreciation by owners and the AEC industry on the benefits of High Performance Buildings (including but not limited to lower life cycle costs including utility and operations costs)
- Utilizing highly collaborative integrated project delivery methods on those projects often lends itself well to advancing the delivering of higher performing buildings

High Performance Building (HPB) Design

- Requires a holistic approach to design and construction which
 - Considers a building's energy load as a whole
 - Integrates energy-efficient measures in order to
 - Reduce demand
 - Reduce off-site generated energy consumption and
 - Results in a high quality product that maximizes the owner's return on investment and reduces their total cost of ownership (life cycle costing vs first cost)

High Performance Building Design (continued)

- Includes all players in some form of an Integrated Project Delivery (IPD) process
 - Owner
 - Design team (a/e)
 - Construction team (materials manufacturers, contractors, waste managers)
 - Operating / maintenance staff
- Processes include to various degrees some form of the following delivery methods: CM/GC, Design-Build, and Integrated Project Delivery
- Often utilizes Building Information Modeling (BIM) as a tool to reach a higher level of project and team performance

According to a 2002 EPA report, ENERGY STAR - labeled office buildings generate utility bills 40% less than the average office building.

New construction high performance corporate headquarters are reporting significant

- Reductions in absenteeism / sick days (example: 15% at Lockheed Martin in CA)
- Increases in productivity ranging from 6 – 26% (from Rocky Mountain Institute)
- Features include: access to pleasant outdoor views, increased daylight, fresh air, and personal light and temperature controls

In Summary

- Even with possible higher first costs for construction of certain high performance building features, these costs are typically recovered within a reasonable payback period.
- Integrated project delivery methods utilizing a multidisciplinary team approach will reduce first and ongoing operating costs
 - Specific project team actions should include:
 - Setting and prioritizing high performance goals in each project's definition, and including those goals in the designer and contractor selection processes
 - Budgeting for any higher first costs
 - Basing decisions on life-cycle cost analyses (LCCA)
 - Using energy modeling to inform the design

In Summary (continued)

- By making the right decisions during design and construction, reductions in operation and maintenance costs can be realized – often with little or not additional up-front costs
 - 2003 State of California commissioned “The Costs and Financial Benefits of Green Buildings” concluded “that minimal increases in upfront costs of about 2 percent would, on average, result in life cycle savings of 20 percent of total construction costs
 - Example - \$10,000 up-front investment on a \$5 mil project would result in a savings of \$1 mil in today’s dollars over the life of the building”

In Summary (continued)

- Federal government's GSA now "requires all new-construction and major modernization projects to be certified through the LEED program, with an emphasis on obtaining Silver ratings."
 - New budget allocations (typically varying between 2.5 and 4.0%) are enough to ensure this can be achieved and project teams are encouraged to achieve the highest level of LEED rating that is practical within the overall budget.
 - This range of estimated construction cost impact for LEED certified, Silver and Gold targeted projects falls below the normal 10+% concept phase estimating accuracy
- Better buildings equate to better employee productivity
- Better engineering systems, etc. enhance occupant health and well being
- Healthier buildings and occupants can increase human productivity and reduce liability

The third Design / Construction / Operations Team Item:

Utilization of Building Information Modeling (BIM)

- Leveraging use of and sharing information through technology (like BIM and related tools) by the designer, contractor and Owner during design, construction and operations appears to potentially be of great value as the State continues to look for ways to benefit from higher performing project teams and projects as well as be more efficient and effective in its projects' delivery
- Utilization of technology, and BIM in particular, has been identified as extremely valuable tool to increase productivity of project teams and improve the quality control of built projects by
 - enabling critical communications and collaboration,
 - sharing of information between different parties,
 - to achieve high performance building goals
 - throughout a project's total life cycle of design, construction and operations

According to McGraw Hill Construction's report "The Business Value of BIM" conducted in 2007 and updated in 2009 and numerous other McGraw Hill Construction BIM reports in July 2009

A total of 2, 228 respondents completed the survey

- Architects / Engineers
 - Large Companies 32% (> \$10 mil in annual income)
 - Medium to Large 13% (\$5 mil to < \$10 mil)
 - Small to Medium 29% (\$500k to < \$5 mil)
 - Small 25% (<\$500k)
- Contractors / Owners / Building Products Companies
 - Large Companies 32% (> \$500 mil in annual income)
 - Medium to Large 13% (\$100 mil to < \$500 mil)
 - Small to Medium 29% (\$25 mil to < \$100 mil)
 - Small 25% (<\$25 mil)

Level of Expertise using BIM

	TOTAL	Beginner	Moderate	Advanced	Expert
• Large Companies	22%	30%	43%	34%	42%
• Medium to Large	27%	32%	23%	25%	21%
• Small to Medium	20%	24%	21%	27%	21%
• Small	32%	14%	13%	13%	16%
• TOTAL	100%	100%	100%	100%	100%

According to McGraw Hill Construction's report "The Business Value of BIM" conducted in 2007 and updated in 2009 and numerous other McGraw Hill Construction BIM reports in July 2009

Owners were looking for BIM to deliver results that can be seen in

- Project cost,
- Speed of delivery,
- Quality of the finished product

Owners using BIM on its projects said it saves time and/or money through

- Increased productivity / efficiency
- Improved coordination of drawings / documents
- Avoiding rework / changes

Additionally they said BIM projects have greater value due to

- Improved collective understanding of design intent
- Reduced conflicts during construction
- Improved overall project quality
- Providing data useful post construction

All industry users surveyed in this report said the top BIM benefits as of 2009 which contribute the most value include:

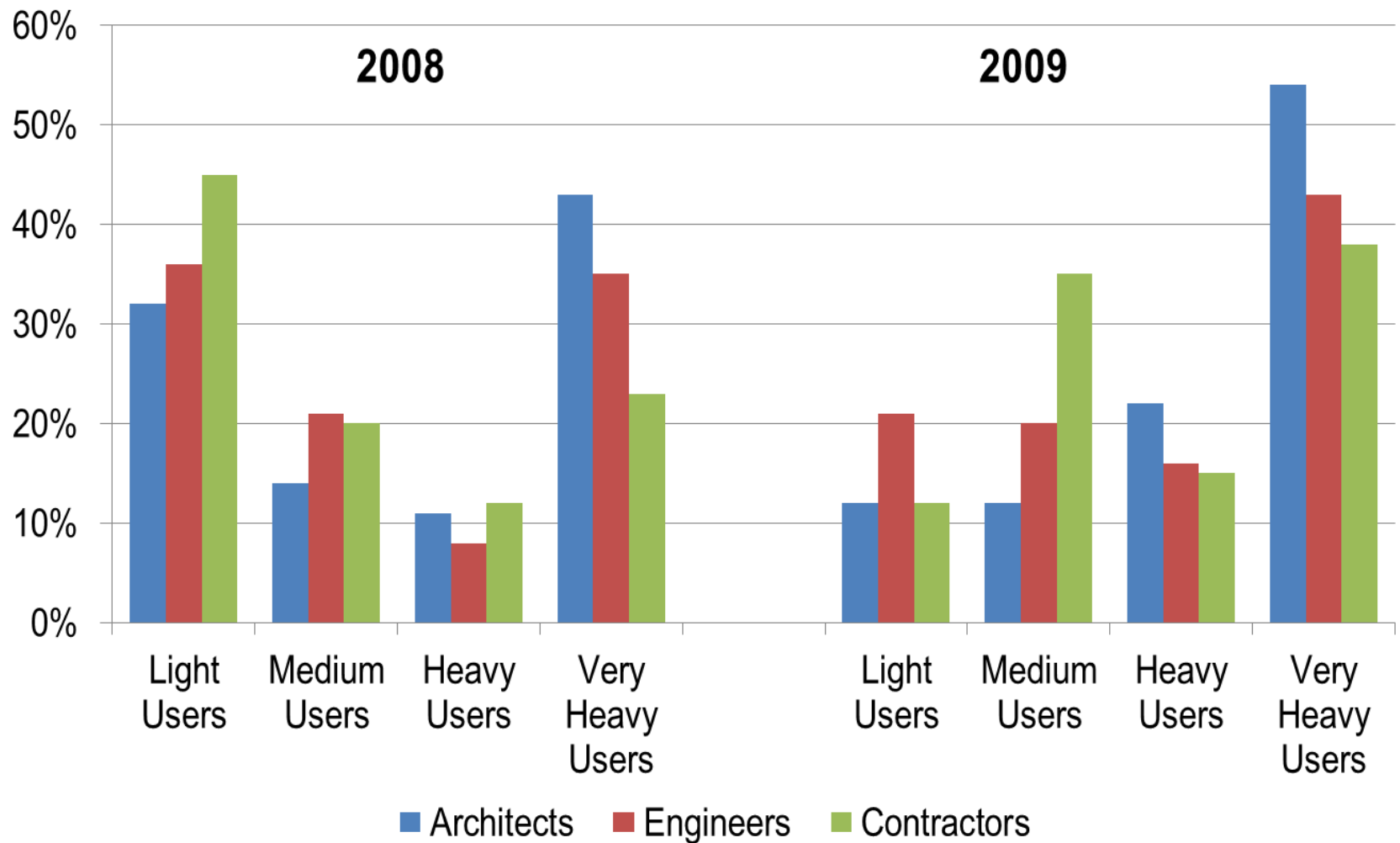
- Improved collective understanding of design intent
 - Thru 3D visualization and a rich database of project information clients, designers and contractors better understand the virtual design of the building before construction
 - Improved overall quality of the project's construction documents
- During Design - Better cost control / predictability of project scope
- During Construction
 - Reduced number of RFIs (Requests for Information) and Change Orders
 - Reduced conflicts during construction
 - Conflicts in drawings found during construction are costly, and typically adversely affect both budget and schedule
 - Reducing conflicts rewards the entire project team - architects, engineers, contractors and the Owner
 - Faster project delivery

Regarding AEC industry adoption of BIM

Fastest growing market segments adopting BIM as of 2009

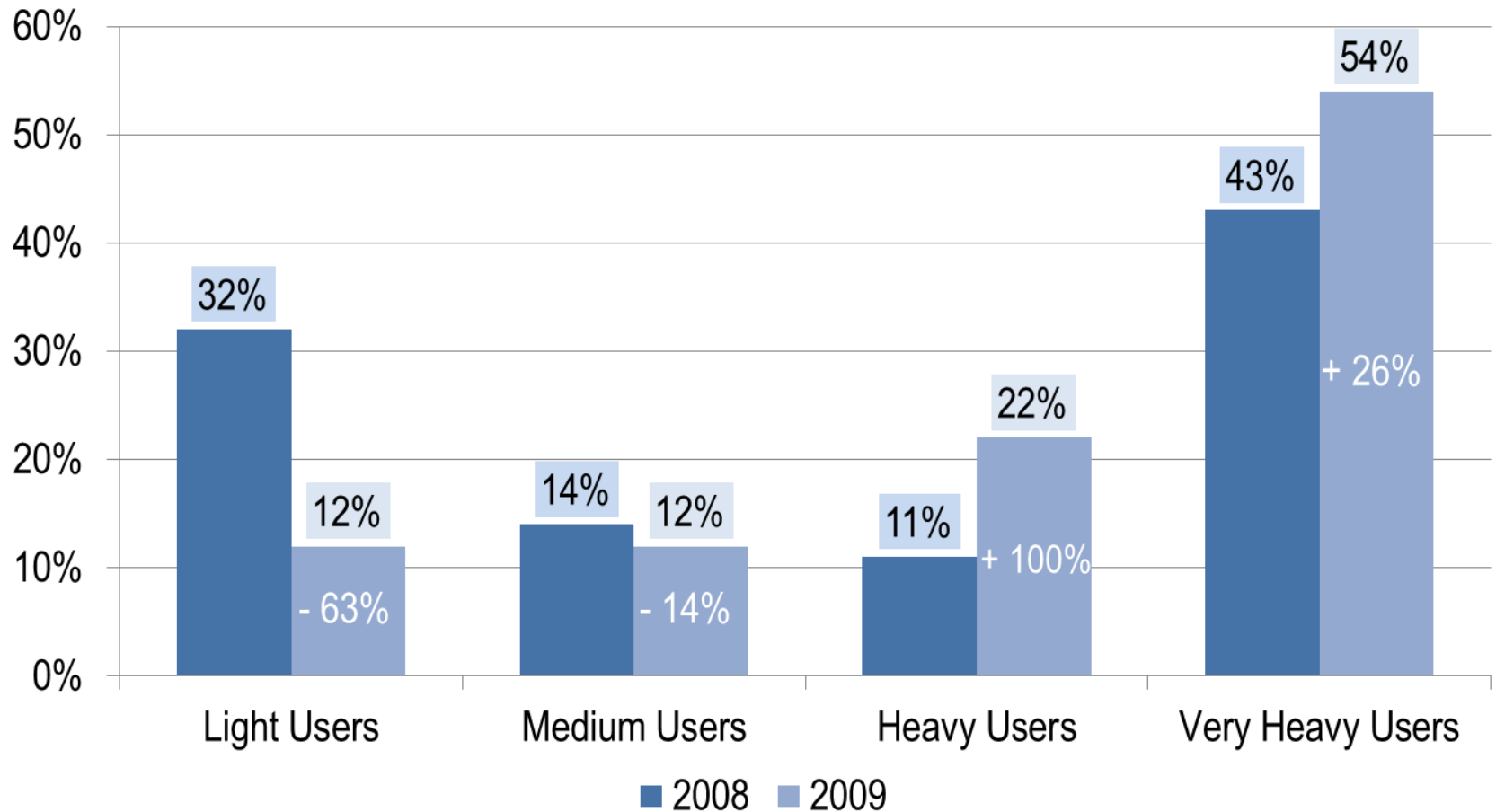
- Public Work 35%
- Health Care 28%
- Education 24%
- Private and other 13%

Growth in BIM Use on Projects



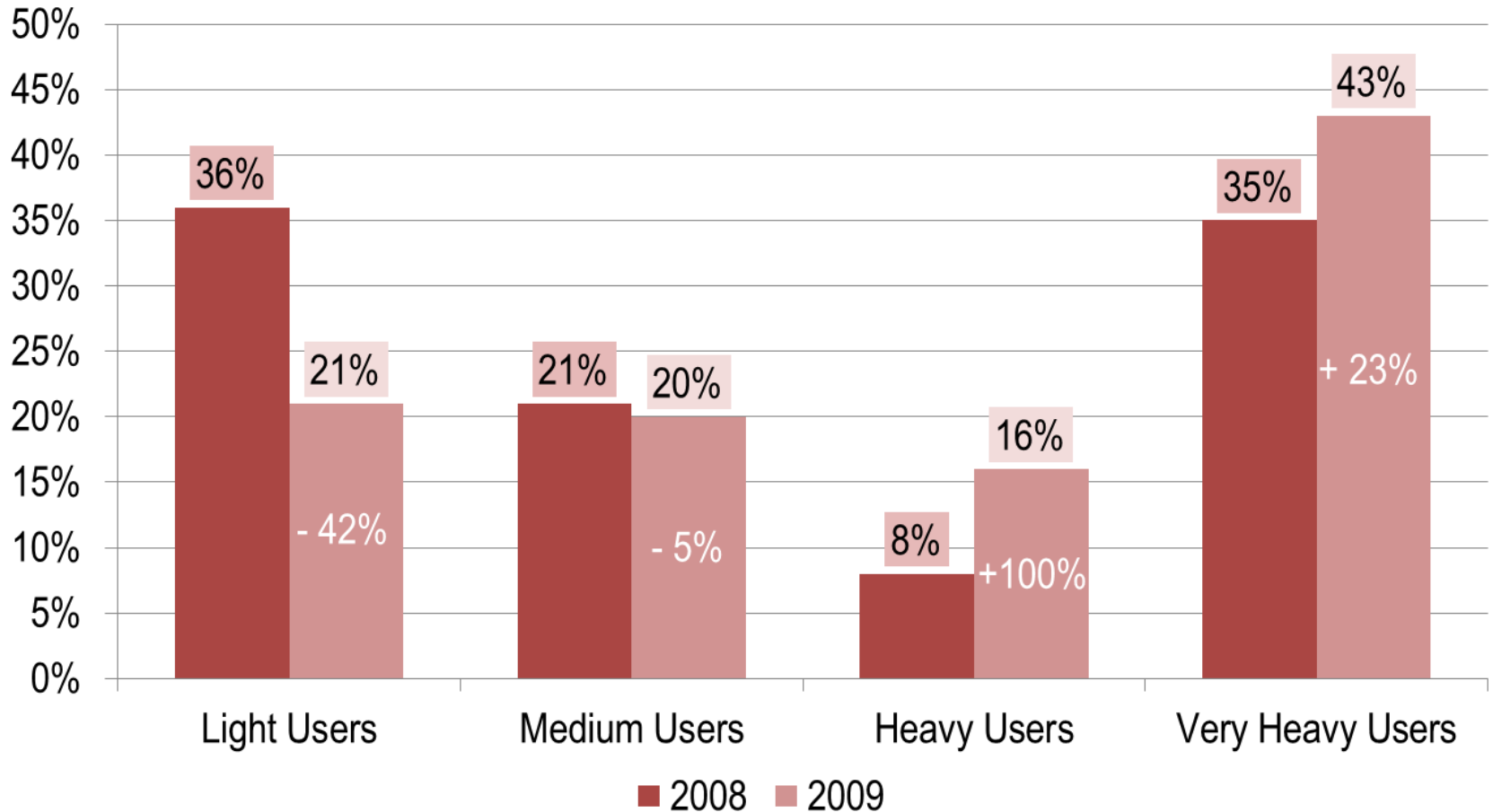
Growth in BIM Use on Projects

Architects



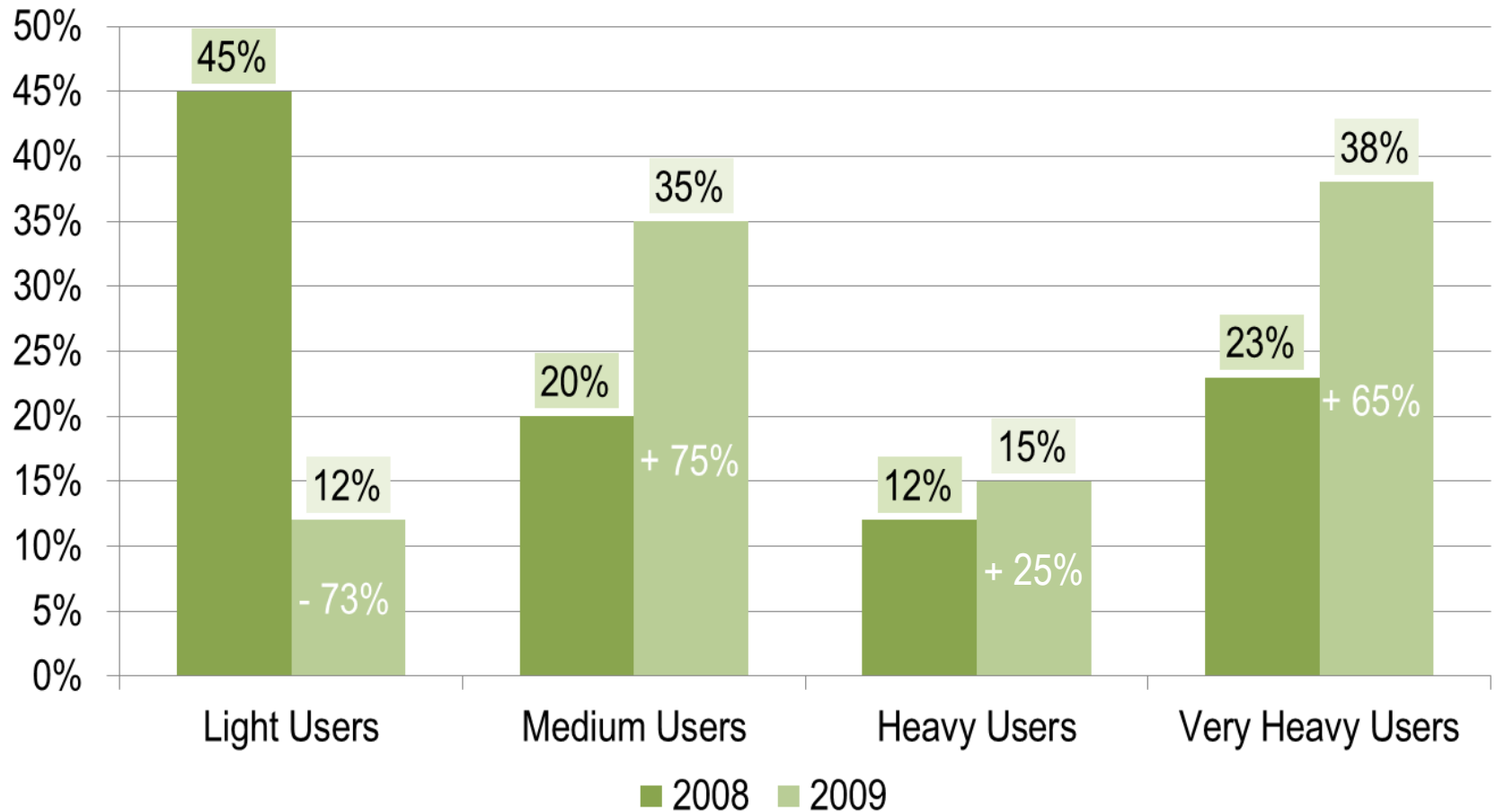
Growth in BIM Use on Projects

Engineers



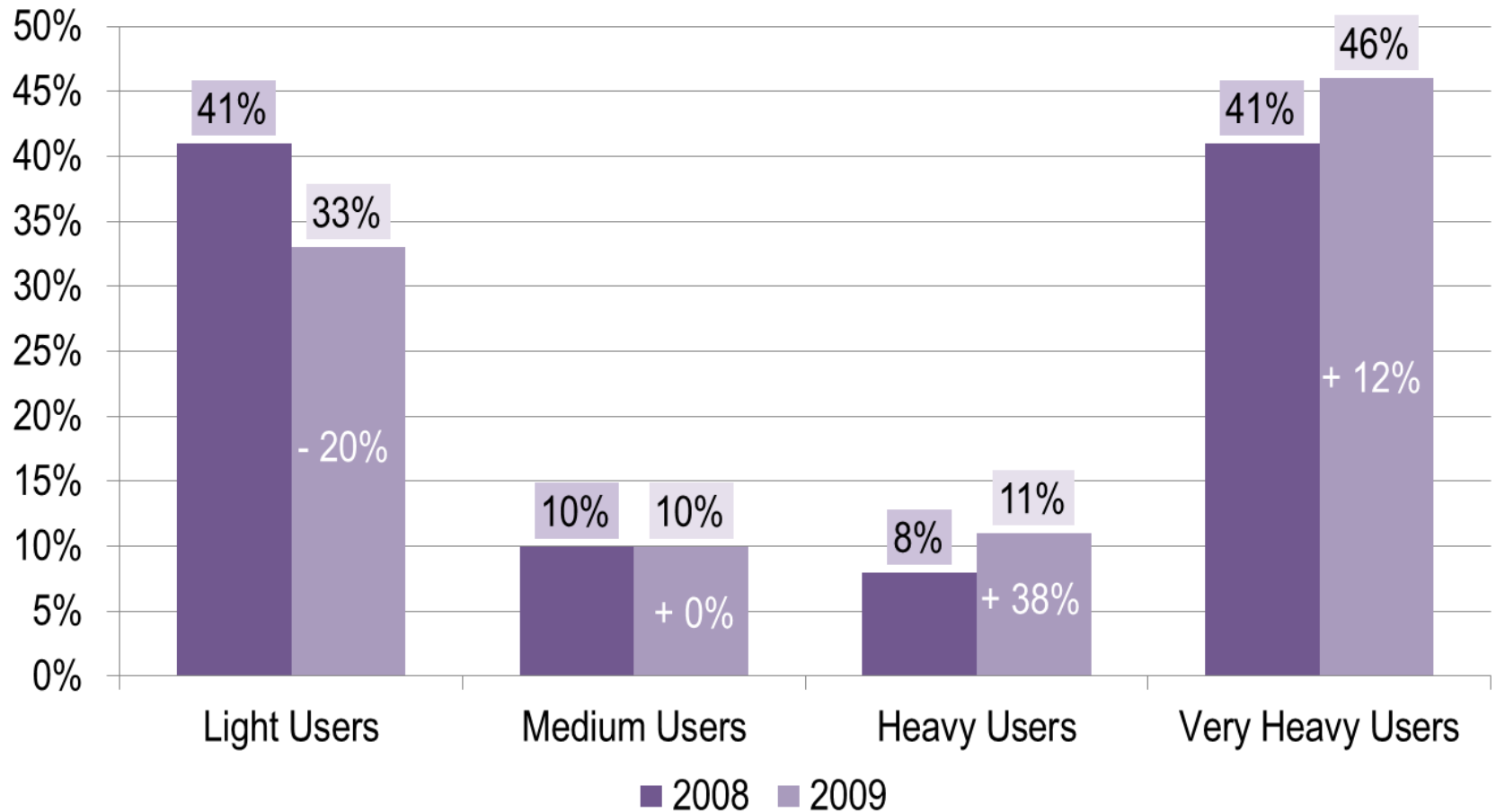
Growth in BIM Use on Projects

Contractors



Growth in BIM Use on Projects

Owners



So where is the State on these three items?

- 1) The SPAs are already looking at utilizing “alternative” delivery methods more often on some of their projects where appropriate
- 2) My office has selected a High Performance Building consultant. Their scope includes developing recommendations for consideration of such tasks as:
 - Return on Investment (ROI) policies
 - Life Cycle Cost Analysis models
 - Energy Modeling requirements
 - HPB Performance Specifications
 - Facility (Post Occupancy) Performance Evaluations/Metrics
 - Updating our Sustainable Design Guidelines (minimum project requirements)

Beyond that there are no definitive plans or SBC approvals to implement any new levels of HPB minimum requirements at this time. This initiative would provide the guidance for well informed decisions if and when any new policies are put in-place in the future.

3) My office has also selected a BIM / Virtual Design & Construction consultant. Their scope will focus on developing recommendations for consideration of design, construction, and operations/facility management phase related items such as:

- Model Development categories
- Model requirements (per project types and sizes)
- Level of Development (LOD) definition
- BIM Execution Plan (BEP) and Deliverables guide
- Implementation/Adoption Plan outline

As with the HPB, there are no definitive plans or SBC approvals to require use of BIM on State of TN projects at this time. If and when the State decides to do so, this consultant's work will provide necessary tools for success.

Questions for the Audience

Construction Delivery Methods

1. Is your office's total volume of project construction delivery methods above the stated industry average in 2010 for each of the following delivery methods?
 - 53% with D-B-B (including Best Value)
 - 41% with D-B
 - 6% with CM/GC

2. How many of you would encourage the State to consider expanding the use of alternative delivery methods (integrated design and construction team approach) in addition to using D-B-B when appropriate? Project delivery methods include:
 - B-V
 - CM/GC
 - IPD

3. Of the delivery methods being discussed below,
- D-B-B
 - Best Value
 - CM/GC
 - Direct-Construct (limited to no designer / documents)
 - Design-Build (full design documents)
 - IPD

Would you expect the D-B-B delivery method will most often result in the least

- a. Number of RFIs?
- b. Number of Change Orders?
- c. Number of time delays?
- d. Cost of construction?
- e. Cost of operations?

4. How many of you believe that more integrated design and construction team alternative delivery methods allow for better
- a. Final design and constructed solutions?
 - b. Higher performing buildings?

High Performing Building Designs

5. How many of your offices are providing high performing building designs to 60% or more of your clients whether requested by them or not?
6. How many of you believe that high performing building designs can lower the total cost of ownership (utility, operating and maintenance costs)?
7. How many of you believe an Owner requiring a 24 month long post construction warranty period would encourage more quality in construction?

Building Information Modeling

8. How many of you are using BIM on a daily basis in your office?
9. How many of you would generally support a public Owner's requirement for a project team's design and construction phase use of BIM?
10. If you are using BIM on a daily basis in your office, how many of you:
 - a. Are using BIM on 60% or more of your projects of the descriptions provided in the previous question?
11. How many of you believe a design team's use of BIM will more often than not result in achieving a higher level of
 - a. construction quality?
 - b. building performance (lower utility, operating and maintenance costs)?

12. How many of you believe the Owner's use of the project's design and construction team's BIM data will more often than not result in achieving more effective owner provided operations, facilities management, etc. over a building's life cycle?
13. How many of you using BIM believe it
 - a. Improves collective understanding of design intent?
 - b. Reduces changes associated with coordination conflicts during construction?
 - c. Improves overall quality of construction documents?
 - d. Provides useful owner data for post construction use during the building's life cycle?
 - e. Improves coordination of drawings?
14. How many are using BIM on projects for the
 - a. Private sector?
 - b. Public sector?

AIA 2012 Tennessee Convention “Boom Town”

July 27, 2012

The following questions were posed to the participants of the AIA Convention using printed questionnaires. The results of the thirty questionnaires received are noted below.

Responding Firms' Size (total number of employees):

Less than 5 employees	3
5 to 50 employees	25
51 to 100 employees	2
101 plus employees	0

Construction Delivery Methods

1. Is your office's total volume of project construction delivery methods above the stated industry average in 2010 for each of the following delivery methods?

	<u>Yes</u>	<u>No</u>
a. 53% with D-B-B (including BV)	60%	40%
b. 41% with D-B	3%	97%
c. 6% with CM/GC	81%	19%

2. Would you encourage the State to consider expanding the use of alternative delivery methods (integrated design and construction team approach) in addition to D-B-B when appropriate? BV, CM/GC, D-B 1, D-B 2, IPD

<u>Yes</u>	<u>No</u>
100%	0%

3. Of the delivery methods being discussed, • D-B-B • Best Value • CM/GC • D-B 1 (limited to no designer / documents) • IPD, which delivery method would you expect will most often result in the least (% of **total** responses):

	<u>DBB</u>	<u>BV</u>	<u>CM/GC</u>	<u>DB-1</u>	<u>DB-2</u>	<u>IPD</u>
a. RFIs	3%	9%	29%	3%	26%	29%
b. Change Orders	3%	7%	37%	3%	20%	30%
c. Time Delays	3%	10%	41%	3%	24%	24%
d. Cost Const.	37%	7%	20%	3%	10%	23%
e. Cost Operations	8%	15%	27%	0%	15%	35%

4. How many of you believe that more integrated design and construction team alternative delivery methods allow for better:

	<u>Yes</u>	<u>No</u>
Final design and constructed solutions	90%	10%
Higher performing buildings	75%	25%

High Performing Building Designs

5. Is your office providing high performing building designs to 60% or more of your clients whether requested by them or not?

Yes

89%

No

11%

6. Do you believe that high performing building designs can lower the total cost of ownership (utility, operating and maintenance costs)?

Yes

100%

No

0%

7. Do you believe required a 24 month long post construction warranty period would encourage more quality in construction?

Yes

70%

No

30%

Building Information Modeling

8. Is your office using BIM on a daily basis?

<u>Yes</u>	<u>No</u>
60%	40%

By number of employees:

	<u>≤ 5</u>	<u>5 to 50</u>	<u>51 to 100</u>	<u>100 +</u>
Yes	33%	68%	100%	n/a
No	67%	32%	0%	n/a

9. Would you support a Public Owner's requirement for a project team's design and construction phase use of BIM on Projects?

<u>Yes</u>	<u>No</u>
86%	14%

By number of employees:

	<u>≤ 5</u>	<u>5 to 50</u>	<u>51 to 100</u>	<u>100 +</u>
Yes	67%	92%	100%	n/a
No	33%	8%	0%	n/a

10. If you are using BIM on a daily basis in your office:

- a. Are using BIM on 60% or more of your projects of the descriptions provided in the previous question?

<u>Yes</u>	<u>No</u>
62%	38%

By number of employees:

	<u>< 5</u>	<u>5 to 50</u>	<u>51 to 100</u>	<u>100 +</u>
Yes	50%	57%	100%	n/a
No	50%	43%	0%	n/a

b. Do you consider your office advanced or expert users?

<u>Yes</u>	<u>No</u>
63%	37%

By number of employees:

	<u>< 5</u>	<u>5 to 50</u>	<u>51 to 100</u>	<u>100 +</u>
Yes	0%	65%	100%	n/a
No	100%	35%	0%	n/a

11. Are you using BIM on projects for:

	<u>Yes</u>	<u>No</u>
Private Sector	67%	33%
Public Sector	71%	29%

Questions and Answers

References

- Associated Builders and Contractors, Inc. (2012). Construction Economics, <www.abc.org/Hot_Links/ConstructionEconomicsIndex.aspx> (Accessed July 15, 2012).
- Carmona, Jorge and Irwin, Kathleen. (October 2007). "BIM: Who, What, How and Why." Facilities Net, <www.facilitiesnet.com/software/article/BIM-who-what-how-and-why--7546#> (Accessed July 15, 2012).
- Design-Build Institute of America. (2012). Industry Research and Reports, <www.dbia.org/pubs/research/> (Accessed July 15, 2012).
- Jones, Stephen. "Integrated Project Delivery," McGraw-Hill Construction, <www.bim.construction.com/research/pdfs/2009_BIM_Adoption_by_US_State_and_Canadian_Province.pdf> (Accessed July 15, 2012).
- Lean Construction Institute. (2012). <www.leanconstruction.org> (Accessed August 27, 2012).
- McGraw-Hill Construction. (2009). "The Business Value of BIM, Getting Building Information Modeling to the Bottom Line," Smart Market Report, <www.bim.construction.com/research/pdfs/2009_BIM_SmartMarket_Report.pdf> (Accessed July 15, 2012).

- McGraw-Hill Construction. (July 2009). "Understanding Perceptions and Usage Patterns of BIM Software Among Key Player Segments," Background, Objectives & Research Methodology,
<www.bim.construction.com/research/pdfs/2009_BIM_Background_Objective_and_Metho dology.pdf> (Accessed July 15, 2012).
- McGraw-Hill Construction. (July 2009). "Understanding Perceptions and Usage Patterns of BIM Software Among Key Player Segments," Executive Summary,
<www.bim.construction.com/research/pdfs/2009_BIM_Executive_Summary.pdf> (Accessed July 15, 2012).
- McGraw-Hill Construction. (July 2009). "Understanding Perceptions and Usage Patterns of BIM Software Among Key Player Segments," Detail Findings – Adoption of BIM Software,
<www.bim.construction.com/research/pdfs/2009_BIM_Adoption_of_BIM_Software.pdf> (Accessed July 15, 2012).
- McGraw-Hill Construction. (July 2009). "Understanding Perceptions and Usage Patterns of BIM Software Among Key Player Segments," Detail Findings – Value from BIM,
<www.bim.construction.com/research/pdfs/2009_BIM_Value_from_BIM.pdf> (Accessed July 15, 2012).

- McGraw-Hill Construction. (July 2009). "Understanding Perceptions and Usage Patterns of BIM Software Among Key Player Segments," Detail Findings – Non-Users of BIM, <www.bim.construction.com/research/pdfs/2009_BIM_Non-Users_of_BIM.pdf> (Accessed July 15, 2012).
- McGraw-Hill Construction. "BIM Adoption: By U.S. State and Canadian Province," <www.bim.construction.com/research/pdfs/2009_BIM_Adoption_by_US_State_and_Canadian_Province.pdf> (Accessed July 15, 2012).
- RCD/RSMMeans Market Intelligence. "Design-Build Project Delivery Used for More Than 40 Percent of Non-Residential Construction Projects, " Design-Build Institute of America, <<http://www.dbia.org/pubs/research/rsmeans110606.htm>> (Accessed July 15, 2012).
- Teicholz, Paul. "Labor Productivity Declines in the Construction Industry: Causes and Remedies." AECbytes Viewpoint. Issue 4. April 14, 2004, <www.aecbytes.com/viewpoint/2004/issue_4.html> (Accessed July 15, 2012).
- The Associated General Contractors of America. (2012). Technology, <www.agc.org/cs/industry_topics/technology> (Accessed July 15, 2012).

- The American Institute of Architects. (2012). "Integrated Practice / Integrated Project Delivery," <www.aia.org/aiaucmp/groups/aia/documents/pdf/aiab089099.pdf> (Accessed July 15, 2012).
- The American Institute of Architects and the Associated General Contractors of America. (2011). "Primer on Project Delivery Second Edition," <www.agc.org/galleries/projectd/AIA-AGC_Primer_on_Project_Delivery_2nd_Edition-FINAL.pdf> (Accessed July 15, 2012).
- The Associated General Contractors of America. (2012). Project Delivery, <www.agc.org/cs/industry_topics/project_delivery> (Accessed July 15, 2012).
- The Charles Pankow Foundation and the Design-Build Institute of America. (2010). "Influence of Project Delivery on Sustainable, High Performance Buildings," Design-Build Institute of America, <<http://www.dbia.org/news/Links/>> (Accessed July 15, 2012).
- U.S. Green Building Council. Fact Sheets and Policy Briefs, <www.usgbc.org/DisplayPage.aspx?CMSPageID=2501> (Accessed July 15, 2012).
- U.S. Green Building Council. "Green Building Facts," <www.usgbc.org/ShowFile.aspx?DocumentID=18693> (Accessed July 15, 2012).

U.S. Green Building Council. "The Business Case,"
<www.usgbc.org/ShowFile.aspx?DocumentID=18691> (Accessed July 15, 2012).

U.S. Green Building Council. "LEED Volume Program," Policy Brief,
<www.usgbc.org/ShowFile.aspx?DocumentID=10836> (Accessed July 15, 2012).